Instruction Manual

Type 570/572

Barocel® Pressure Sensor

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EDWARDS

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NOTES:

- The term 570, as used in this manual, applies to both the Type 570 and Type 572 Barocel® Sensors.
- This manual references the manuals of the associated Electronic Manometer and Thermal Base (applicable only if a Thermal Base is being used). The manuals for these products will be necessary for installation and operation.

Section 1
Product Description

General Information

The Edwards Type 570/572 Barocel® is a precision vacuum/pressure sensor. Advanced design features, which incorporate a capacitive diaphragm gauge, allow precision measurement over a wide input pressure range with long-term stability and zero repeatability. All-welded construction, with no elastomer seals, makes it suitable for use in high vacuum systems.

The Type 570 is the sensor element in an Edwards vacuum/pressure measurement system. It can be used with Edwards Type 1018 and 1174 Electronic Manometers or Type 1015 Signal Conditioner.

The Type 570 is available with either a single pressure port for absolute measurement, or with dual pressure ports for gauge or differential measurement.

Features

Differential, absolute, or gauge measurements

High accuracy and resolution

True total pressure reading

In-System Performance Tests

Equipment Supplied

Type 570/572 Barocel® Transducer

A mating pressure fitting (optional)

Cable Connector and Strain Relief

Barocel Calibration Data

Instruction Manual

Identification of Controls

The momentary CAL button or four pin electrical connector to a remote CAL switch is located above the electrical connector.

Section 1
Product Description

Applications

The 570 can be used in a wide range of applications:

Vapor Pressure	Vacuum Gauging	Gauge Calibration
Mass Spectroscopy	Cryogenics	Leak Detection

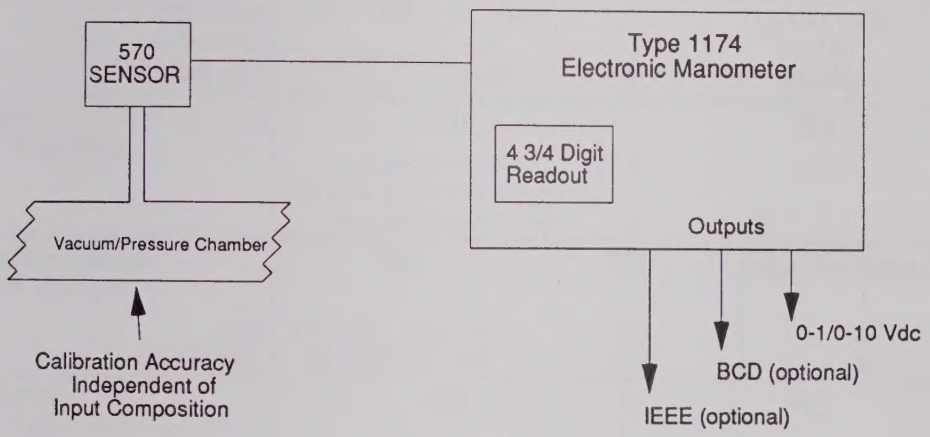

Figure 1 - Application Block Diagram

Physical Description

NOTE: When using to a Thermal Base, consult the manual for that product for mounting instructions.

Weight: 2.2 lbs (1 kg)

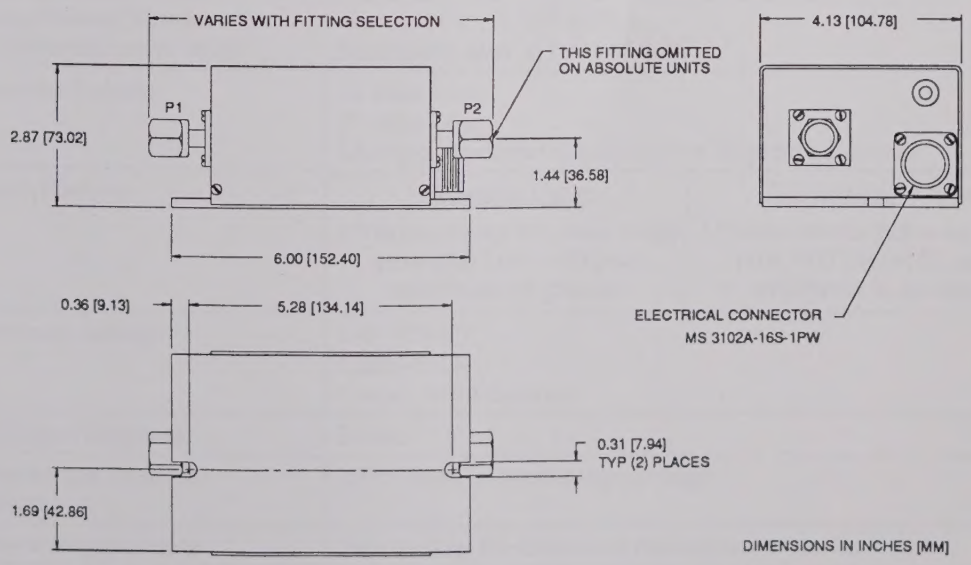

Figure 2 - Outline Dimensions

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Section 1
Product Description

Technical Specifications

NOTES:

- These specs apply to sensor only. Consult specs of all components to determine total system performance.
- Specifications are subject to change without notice. Refer to manual cover for date of publication.

Ranges: torr/mbar inches HG inches H_20	570 1, 10, 100, 1000 10, 100 1, 10, 100		572 10, 100, 1000 10, 100 10, 100
Accuracy: (% of reading)	570 ±.15 (standard) (±.10 & ±.05 optional except on 1 torr/mbar/"H_20)		572 ±.03
Temperature Effects: (% of full scale per °C) zero sensitivity	570 .003 (.001 optional) .03 (.02 optional)	572 .001 .01	all 1 torr/mbar/"H_20 .02 0.1
Repeatability: (% of maximum applied pressure)	570 0.005		572 0.003
Material Exposed to Media:	Inconel, palladium silver, monel, nickle, glass ceramic (2MGO, SiO_2), 316 SS (304)		
Operating Temperature: (°C)	5 to 70		
Resolution:	1 part in 10^6 of sensor full range		
RFI Suppression:	Standard on all models		
Line Pressure Effects: (differential units only)	Zero shift < 1 X 10^{-4} % FS Sensitivity shift < 1 X 10^{-4} % FS		
Internal Volume:	P1 side: 5.3cc P2 side: 7.6cc Changes approximately 0.16cc for FS pressure change		
Overpressure:	Absolute Units 1.5 times sensor full scale range plus 1000 Torr or 20 psia, whichever is greater.		Differential Units 1.5 times sensor full scale range plus 1000 Torr or 20 psid, whichever is greater.
Pressure Fittings:	1/8"-27NPT Cajon 4VCR Varian Mini-Conflat		
Transient Response:	8 msec		
Diaphragm Resonant Frequency:	2700 - 5500Hz, depending on range		
Power Requirements:	Provided by the associated manometer or power supply		
Weight:	2.2 lbs (1 kg)		

Section 1
Product Description

Theory of Operation

The pressure-sensing element in the Barocel® Transducer is a high-precision stable capacitive potentiometer, the variable element being a thin, highly prestressed metal diaphragm. Positioned between fixed capacitor plates, the diaphragm forms the separation between two gas-tight enclosures which are connected to the external pressure ports. A difference in total pressure within the enclosures produces a force which deflects the diaphragm and varies the relative capacitance of the diaphragm to the fixed capacitor plates. The Barocel® is electrically arranged in a 10 KHz carrier-excited bridge which becomes unbalanced by the deflection of the diaphragm. This produces a 10 KHz voltage of amplitude proportional to applied pressure.

The 10 KHz voltage output from the bridge is fed through an emitter follower circuit and output to an electronic manometer or signal conditioner.

The electronic manometer provides power and the 10 KHz carrier signal to the Type 570.

The diaphragm is permanently welded to massive support rings to provide long-term stability and ultra high repeatability.

In overpressure conditions the diaphragm will make contact with one of the static capacitor plates, which takes up the load and prevents damage to the diaphragm.

Dimensional changes due to temperature produce no net change in relative capacitance, which improves zero stability.

In absolute units, the vacuum reference contains a getter to capture outgassing and ensure long operating life, thus eliminating the need for reference pumps.

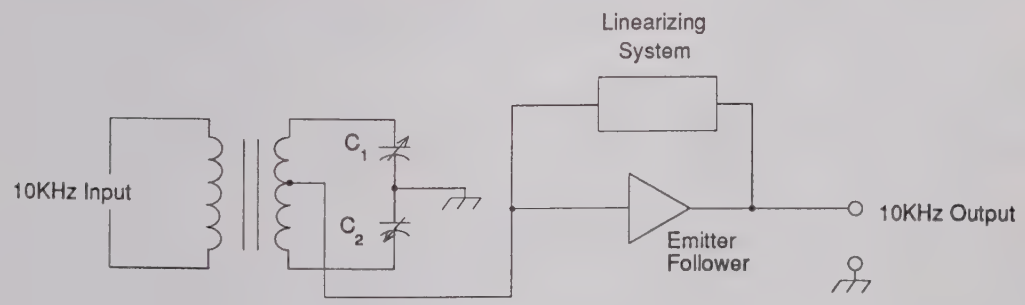

Figure 3 - 570 Block Diagram

Section 2
Installation

Inspection

When received, the instrument should be examined for damage during shipment, and an inventory should be taken of the equipment supplied. (See *Equipment Supplied*, Section 1).

Recommended Auxiliary Equipment

Type 1174 Electronic Manometer	Digital display, manual range changing.
Type 1018 Electronic Manometer	High accuracy, digital display, manual & automatic range changing.
Type 1015 Signal Conditioner	High accuracy.
Type 528 Thermal Base	Improves transducer stability.

General Notes on Absolute Barocel® Sensors (500 Torr or less)

Barocel® Sensors experience a small non-repeatability of zero which is caused by overpressure to the diaphragm. This non-repeatability is typically equal to .02% of the applied pressure, which can be significant. This zero shift can be eliminated by evacuating the measuring inlet to a pressure whose value is insignificant when compared to measuring accuracy and adjusting the ZERO control. (See *Zero Adjustment* in Section 3). This eliminates the zero errors caused by overpressure and by variation in ambient temperature.

When working with pressures below 1000 torr, it can be advantageous to mount a blanking valve in series with the pressure inlet so that before the vacuum system is open to the atmosphere the valve can be closed, thereby holding the vacuum at the sensor inlet to no more than 20% over full scale.

Interface Cable Connections

Electrical connections to the Type 570 are made via an MS 3102A-16S-1SZ connector.

Figure 4 depicts connection to a Type 1174 Electronic Manometer via a Type W579 99 005 Interface Cable.

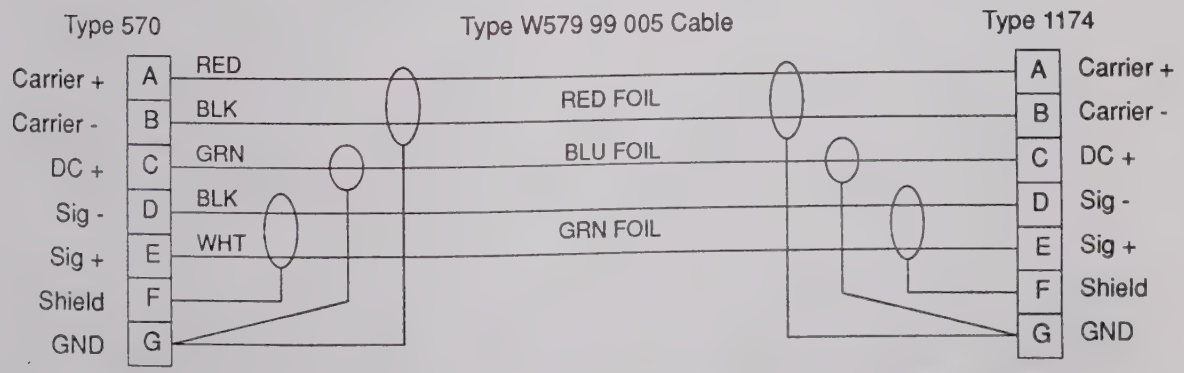

Figure 4 - Connection to Type 1174 Electronic Manometer via Type W579 99 005 Cable

Section 2
Installation

Mounting

General

The mounting of the sensor and tubulation has a considerable effect on system performance. Short tubing will decrease adverse effects such as outgassing, but may place the sensor too close to a source of vibration or thermal variation. Longer tubing may alleviate the sensor issues but in turn create tubing problems.

As applications and environments vary from one user to the next, Edwards recommends thorough monitoring of system performance following installation. If unsatisfactory performance is detected, sensor placement and tubing should be considered as potential problem areas.

Tubulation

Keep tubing as short as is practical, with consideration to sensor location.

Tubulation should be kept free of dust, metal chips, and liquids.

Flexible tubing should be securely anchored to prevent undesired pressure changes.

Frequency response decreases as tubing length increases.

The dual tubing of differential units should run side-by-side, twisted if possible. This applies especially to low range units measuring differentially at high pressure.

Plastic or rubber pressure connection tubing should be avoided at low absolute pressures as they will outgas and give false pressure readings.

At pressures above 100 Torr absolute:

- Nylon, Polyethylene, Teflon, metal, or rubber tubing is acceptable.

At pressures below 100 Torr absolute:

- Metal tubing is desirable under these conditions.
- Use vacuum-quality fittings and hardware.
- Inner diameter of tubing should be as large as is practical to accelerate outgassing.

Sensor Placement

The Type 570 may be mounted in any position. It should be located as close as possible to the pressure source.

Protect the sensor from transient sources of heat or cold such as drafts, heaters, air conditioners etc. Temperature changes can also be introduced by way of the pressure connection.

NOTE: If a Thermal Base is going to be used, follow the mounting instructions for that device.

Vibration

The transducer is most sensitive to vibration along the axis perpendicular to the plane of the diaphragm. Vibration produces noise in the DC output which may affect the pressure readout. The effect of vibration can be reduced by selecting the optimum mounting orientation of the transducer or by mounting it on an vibration isolator.

Mechanical vibration will cause noisy pressure readings particularly in low range absolute transducers where air damping of the diaphragm is absent. To minimize vibration problems, such as may occur from motor driven vacuum pumps, the sensor can be mounted to a padded support and a metal bellows inserted between the pressure port and the source of vibration.

Section 2
Installation

Pneumatic Connections

Pressure Polarity

Unless otherwise specified, sensor accuracy is optimized for positive pressure on P1, which will yield a positive output signal. For differential measurements, connect the reference to P2.

Model Tapped for Customer Installed 1/8-27 NPT

Do not exceed 250 inch pounds torque. The front surface of the port is machined flat to accept "O" ring fittings similar to Swaglok 301-A-2-OR. Do not score this surface with tools when attaching fittings.

> **CAUTION**
>
> Do not use sealing compounds.
>
> Use Teflon® tape around the threads to insure a leak-free joint.

Quick Disconnect Fittings

Fittings of this style designed to receive either 1/8 or 1/4 o.d. tubing may be installed. The correct diameter is the smallest that will clear the fitting.

The tubing must be round, polished, and unscored for the "O" ring to provide a good seal. Inspect both the "O" ring and the tubing at every disassembly.

Unscrew the knurled fitting until the "O" ring is uncompressed and insert the tubing until it bottoms against the inside of the fitting (approximately 1/2"). Ensure that the "O" ring is seated properly .Tighten the knurled fitting with your fingers only; excessive force yields no benefit.

The tubing is held in the fitting by the frictional force of the "O" ring only. If axial stress on the tubing is anticipated, external support is necessary.

At pressures exceeding 1250 torr, gage, external tubing support is necessary.

NOTE: An "O" ring seal is effective only to 10^{-7} scc/s.

Cajon Fittings

Ensure that polished surfaces are clean and that the aluminum or nickel gasket is in place. Use two wrenches to tighten the fitting; one on the main body of the fitting and the other on the threaded bushing. Torque per following table.

Gasket Material:	Inch Pounds of Torque
Aluminum	125
Nickel	250

Disconnect the sensor during any welding or brazing to the mating fitting. When finished, clean the tubing thoroughly inside and out. Replace nickel or aluminum gasket if dismantled.

Section 2
Installation

Conflat Fittings

Ensure that external tubulation is properly aligned to the sensor. The use of short bellows in one line will accommodate misalignment. Disconnect the sensor during any welding or brazing to the mating fitting.

CAUTION

Disconnect Sensor from system during any soldering, brazing, or welding in the system to prevent contamination from vaporization, condensation, etc.

Excessive heat from these operation will damage the Sensor.

Section 3
Operating Information

Warm Up and Temperature Effects

The Type 570 requires a period of three hours to stabilize after either power-on or a change in ambient temperature. See Temperature Coefficient Spec in *Technical Specifications*. Check for Zero shift after any change in ambient temperature.

A thermal base and cover will minimize temperature effects. See below, *Type 528 Thermal Base.*

Run the Type 570 constantly to ensure optimum performance.

Type 528 Thermal Base

The Type 528 Thermal Base improves transducer stability in environments prone to fluctuating temperatures. It is designed for use with 570 & 572 sensors and 590 Barocel® transducers.

- Heater temperature is switch selectable at 40 and 80 °C.
- Line voltage is switch selectable at 115 and 230 VAC.
- Reduces internal transducer condensation.

The Type 577 Insulating Cover will maximize the effect of the 528 Thermal Base.

See *Auxiliary Equipment Codes* in Section 6.

Overpressure

CAUTION To avoid damage to the sensor, do not exceed:	
Absolute Units	Differential Units
1.5 times sensor full scale range plus 1000 Torr or 20 psia, whichever is greater.	1.5 times sensor full scale range plus 1000 Torr or 20 psid, whichever is greater.

When exposed to pressures exceeding full scale range, sensor output is unreliable.

In-System Performance Check

There are several features of an Edwards vacuum/pressure measurement system that allow the user to verify the function and accuracy of the system during operation.

- Sensor CAL button - this feature provides the user with essentially a known pressure standard.
- Quad and Zero - the need to frequently adjust these parameters indicates faulty tubulation, excessive thermal variation in the sensor environment, or contamination of the sensor.

Section 3
Operating Information

Zero Adjustment

The system should be periodically checked for a zero pressure reading. Adjustments are made via the Sensor Zero Adjustment on the associated Electronic Manometer. The instruction manual of that unit contains the information below concerning zero adjustment.

If the Zero Adjustment on the associated Electronic Manometer cannot bring the display to zero, it may be necessary to adjust the internal zero adjustment of the sensor. See *Internal Adjustments*, Section 4.

Differential Units

Set the pressure across the sensor to zero via an enclosed pneumatic short and adjust as necessary.

NOTE: A totally enclosed pneumatic short is necessary to obtain a true zero pressure differential across the sensor. It must be isolated from the system to ensure the absence of any residual flow. A valve-controlled bypass short across the sensor will not yield a zero pressure differential unless it is totally enclosed. Do not zero the sensor with ports open to atmosphere.

Absolute Units

Evacuate the sensor to a pressure lower than the readout resolution (see table below) and adjust as necessary.

Note that the pressures listed below are maximum zeroing pressures; lower pressures are desirable in applications that are zero sensitive.

Sensor Full Range In Torr	Zeroing Pressure (in mtorr) must be less than:	
1000	100	10
100	10	1
10	1	0.1
1	0.1	0.01
# of Readout Digits	3 1/2	4 1/2

Figure 5 - Zero Adjustment Table

Cal Adjustment

A number designated as CAL is located on the label of the Type 570. This number represents a percentage of the unit's full scale output. When the momentary CAL button is depressed and held, the unit's output is increased by that percentage of full scale.

Refer to the Instruction Manual of the associated Electronic Manometer for the Cal Adjustment procedure.

Section 4
Maintenance

Routine Maintenance

No routine maintenance is necessary if the gases being measured are clean, non-condensable and dry. The vacuum/pressure chamber can be occasionally heated and then pumped to vacuum to purge most of the moisture from the system. The zero can be checked and set as outlined in the *Zero Adjustment* in Section 3.

Cleaning

Edwards does not recommend that the customer attempt to clean a Type 570. Units requiring cleaning should be returned to Edwards.

Internal Adjustments

If adequate pressure standards are available the sensor may be recalibrated. If linearity is not within specification, return for factory calibration. The location of the adjustments are shown below in Figure 8.
NOTE: Both the zero and sensitivity may change with the cover removed.

CAUTION

Only Qualified Personnel should remove the cover and/or attempt adjustments.

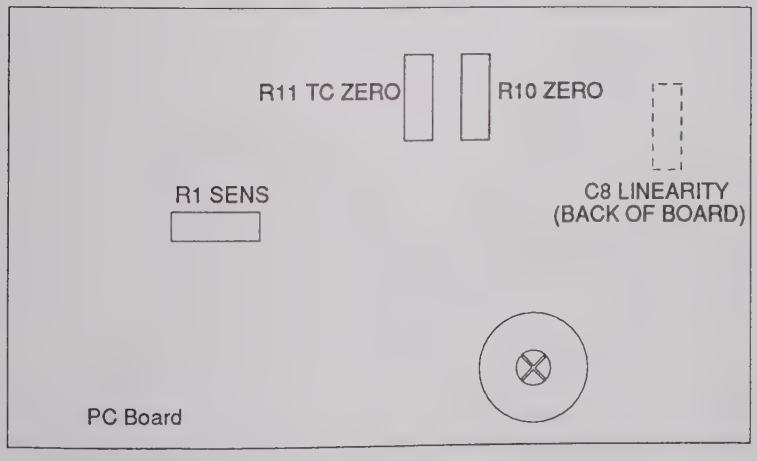

Figure 6 - Internal Adjustments

Section 5
Troubleshooting Guide

Technical Assistance

Edwards Technical Support Managers are available to assist you should you have a problem with your equipment. Call 1-800-848-9800 and ask for Customer Service.

System

Listed below are guidelines for use in diagnosing some common problems.

Problem	Probable Cause
ZERO adjustment out of range.	Pressure is not low enough due to inadequate vacuum pump, leaks in tubulation or joints, dirt ingested into cell. If the reading is too negative, the cell vacuum reference may have degraded due to a leak to atmosphere. Excessive overpressure may have caused a zero shift.
Large ZERO drift with time	Ambient temperature may be changing excessively. Reference vacuum going bad will cause a negative drift.
Large scale factor errors (as determined by pressure standard).	Dirt in cell. Zero may also have shifted.
Short Term ZERO drift after a large over-pressure is applied.	"Creep-back" of the diaphragm.
No output with applied pressure.	Short or open circuit in cabling or other electrical malfunctions.
Dirt in cell	Should be cleaned only at the factory. Untrained personnel will damage the diaphragm.
Leaks in tubing	Look for leaks by isolating various portions of the tubing and observing the pressure change with the sensor output. In vacuum systems, consideration should be given to gassing of the cell and permeation through "O" rings.

Cables

The cables can be checked in either of two ways. Connect the suspected cables between a good display and a good sensor, and check readings. Disconnect cables, check for fraying or short circuits, and check with an ohmmeter for continuity or shorts.

Ordering Schematics

Schematics are available form Edwards at a nominal price to cover printing and postage. Contact Edwards Sales at 1-800-848-9800.

Section 6
Ordering Information

Contacting Edwards Sales

For product information, call Sales at 1-800-848-9800.

570/572 Order Codes

Example P/N: 72W 571 21 411
Field #: 1 2 3 4 5 678

Field #	Field Description	Detail.....Code
1	Product Group	Pressure.....72
2	Site	Wilmington.....W
3	Model	570.....57
4	Type	Differential.....0 Absolute.....1
5	Range	1 Torr .....11 (w/ Thermal Base & Cover) 10 Torr.....21 100 Torr.....31 1000 Torr .....41 1 MBar.....12 (w/ Thermal Base & Cover) 10 MBar .....22 100 MBar.....32 1000 MBar.....42 10" H_2O.....50 100" H_2O.....60 10" HG.....70 100" HG 80
6	Pressure Fitting	1/8" 27 NPT.....2 Mini-Conflat.....3 Cajon 4 VCR .....4 NW-16.....8
7	Accuracy	0.15%.....1 0.10.....2 0.05% (not 1 torr/mbar).....3
8	Temp Coefficients	.003% / °C zero and .03% / °C slope.....1 .001% / °C zero and .005% / °C slope.....2 All 1 torr/mbar units: 9

NOTE:
Unit options are subject to change without notice. Contact Sales for latest product information. Refer to manual cover for date of publication.

EDWARDS HIGH VACUUM - DATAMETRICS PRODUCTS
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MECHANICAL WARRANTY

For a period of twelve (12) months from the date of original shipment to Purchaser, the apparatus and each part or component manufactured by Edwards High Vacuum International (Edwards) is warranted to be free from functional defects in materials and workmanship. The foregoing warranty is subject to the condition that the apparatus, part, or component be properly operated under conditions of normal use and that regular periodic maintenance and service be performed or replacements made in accordance with instructions provided by Edwards. The foregoing warranty shall not apply to any apparatus, part, or component that has been repaired other than by Edwards or an authorized Edwards representative or in accordance with written instructions provided by Edwards, that has been altered by anyone other than Edwards or that has been subject to improper installation or abuse, misuse, negligence, accident, or corrosion.

Purchaser's sole and exclusive remedy under the above warranty is limited to, at Edwards' option, repair or replacement of defective parts or components or return to Purchaser of the price of the apparatus. The defect must be promptly reported to Edwards and Purchaser must return the part or component with a statement of the observed deficiency not later than seven (7) days after the expiration date of the warranty to the address designated by Edwards, transportation charges prepaid. In the event that Edwards elects to refund the purchase price, the apparatus shall be the property of Edwards and shall be promptly shipped to Edwards at Edwards' expense. This Mechanical Warranty shall be void and the apparatus shall be deemed to be purchased AS IS in the event that the entire purchase price has not been paid within thirty (30) days of original shipment of the apparatus.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES THAT EXTEND BEYOND THE WARRANTY HEREINABOVE SET FORTH. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE APPARATUS OR ANY PART OR COMPONENT THEREOF AND NO WARRANTY SHALL BE IMPLIED BY LAW.

Items not of Edwards' manufacture but resold by Edwards are the products of other manufacturers and their warranty, if any, shall apply. THERE ARE NO WARRANTIES OF ANY KIND ON PRODUCTS OF OTHER MANUFACTURERS RESOLD BY EDWARDS EXCEPT THE WARRANTY OF TITLE. AND NO WARRANTIES SHALL BE IMPLIED BY LAW. THERE IS NOT EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO PRODUCTS OF OTHER MANUFACTURERS. In no event shall the Purchaser be entitled to any special, indirect, or consequential damages.

Section 6
Ordering Information

Auxiliary Equipment Order Codes

Thermal Base:

Type 528 Thermal Base (40 & 80°C)	72W 579 91 300

Insulating cover:

Type 577 (for 570 transducer)	72W 599 93 000

Readout/Controllers:

Type 1174 Electronic Manometer	72W 574 01 100 (115Volt, bench-mount unit)
requires cable #	72W 579 99 005 (15')
Type 1018 Electronic Manometer	72W 575 11 100 (115Volt, bench-mount unit)
requires cable #	72W 579 99 005 (15')

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